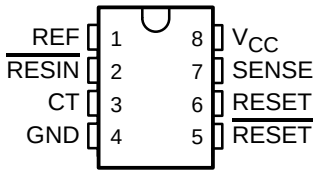
TL7702B, TL7705B, TL7733B
SUPPLY-VOLTAGE SUPERVISORS

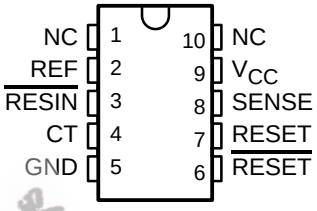
SLVS037L – SEPTEMBER 1989 – REVISED MAY 2002

- **Power-On Reset Generator**
- **Automatic Reset Generation After Voltage Drop**
- **$\overline{\text{RESET}}$ Output Defined From $V_{CC} \geq 1$ V**
- **Precision Voltage Sensor**
- **Temperature-Compensated Voltage Reference**
- **True and Complement Reset Outputs**
- **Externally Adjustable Pulse Duration**

TL77xxBC . . . D OR P PACKAGE
TL7705BM . . . JG PACKAGE
TL7705BQ . . . D PACKAGE
(TOP VIEW)

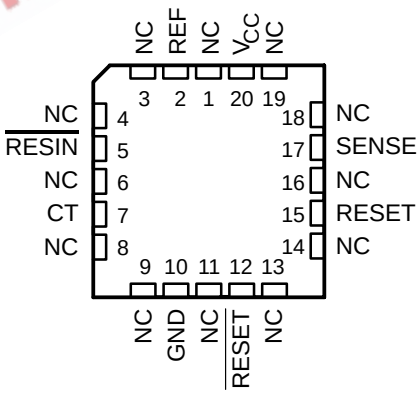


TL7705BM . . . U PACKAGE
(TOP VIEW)



NC – No internal connection

TL7705BM . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description

The TL7702B, TL7705B, and TL7733B are integrated-circuit supply-voltage supervisors designed for use as reset controllers in microcomputer and microprocessor systems. The supply-voltage supervisor monitors the supply for undervoltage conditions at the SENSE input. During power up, the $\overline{\text{RESET}}$ output becomes active (low) when V_{CC} attains a value approaching 1 V. As V_{CC} approaches 3 V (assuming that SENSE is above V_{T+}), the delay timer function activates a time delay, after which outputs $\overline{\text{RESET}}$ and RESET go inactive (high and low, respectively). When an undervoltage condition occurs during normal operation, outputs $\overline{\text{RESET}}$ and RESET go active. To ensure that a complete reset occurs, the reset outputs remain active for a time delay after the voltage at the SENSE input exceeds the positive-going threshold value. The time delay is determined by the value of the external capacitor C_T: $t_d \approx 2.6 \times 10^4 \times C_T$, where C_T is in farads (F) and t_d is in seconds (s).

An external capacitor (typically 0.1 μF) must be connected to REF to reduce the influence of fast transients in the supply voltage.

The TL7702BC, TL7705BC, and TL7733BC are characterized for operation from 0°C to 70°C. The TL7702BI, TL7705BI, and TL7733BI are characterized for operation from –40°C to 85°C. The TL7705BQ is characterized for operation from –40°C to 125°C. The TL7705BM is characterized for operation from –55°C to 125°C.

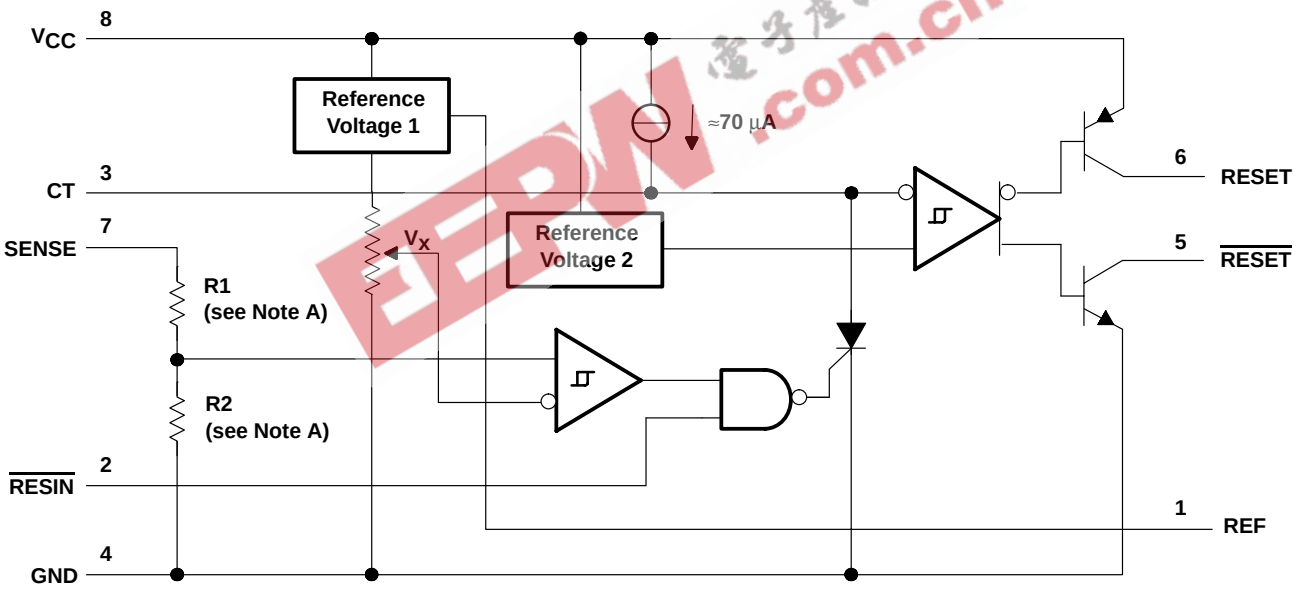
AVAILABLE OPTIONS

T_A	PACKAGED DEVICES				
	SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CERAMIC FLATPACK (U)
0°C to 70°C	TL7702BCD	—	—	TL7702BCP	—
	TL7705BCD	—	—	TL7705BCP	—
	TL7733BCD	—	—	TL7733BCP	—
–40°C to 85°C	TL7702BID	—	—	TL7702BIP	—
	TL7705BID	—	—	TL7705BIP	—
	TL7733BID	—	—	TL7733BIP	—
–40°C to 125°C	TL7705BQD	—	—	—	—
–55°C to 125°C	—	TL7705BMFK	TL7705BMJG	—	TL7705BMU

The D package is available taped and reeled. Add the suffix R to device type (e.g., TL7702BCDR).

functional block diagram

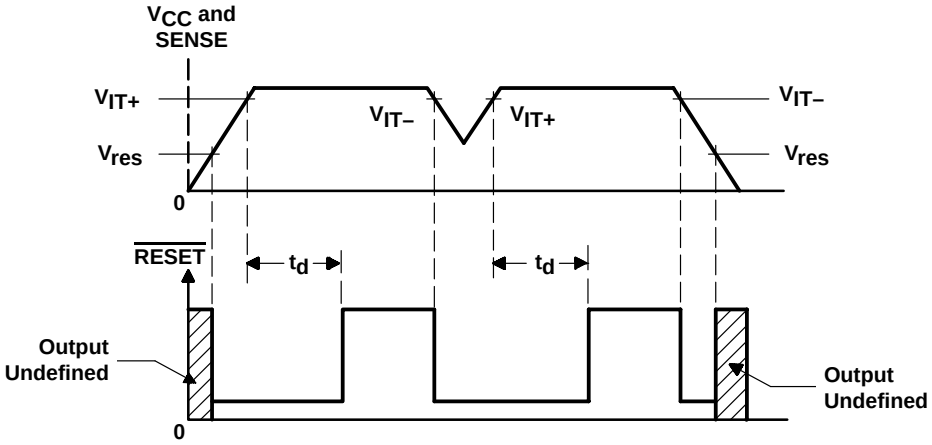
The functional block diagram is shown for illustrative purposes only; the actual circuit includes a trimming network to adjust the reference voltage and sense-comparator trip point.



Pin numbers shown are for the D, JG, and P packages.

NOTE A: TL7702B: R1 = 0 Ω, R2 = open, $V_X = V_{REF1}$
TL7705B: R1 = 23 kΩ, R2 = 10 kΩ, nominal, V_X ≈1.43 V
TL7733B: R1 = 11.3 kΩ, R2 = 10 kΩ, nominal, V_X ≈1.43 V

typical timing diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{CC} (see Note 1) . . . . . 20 V
Input voltage range, V_I: $\overline{\text{RESIN}}$ . . . . . –0.3 V to 20 V
SENSE . . . . . –0.3 V to 20 V
High-level output current, I_{OH} ($\overline{\text{RESET}}$) . . . . . –30 mA
Low-level output current, I_{OL} ($\overline{\text{RESET}}$) . . . . . 30 mA
Package thermal impedance, θ_{JA} (see Notes 2 and 3): D package . . . . . 97°C/W
P package . . . . . 85°C/W
Case temperature for 60 seconds, T_C: FK package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG or U packages . . . . . 300°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or P packages . . . . . 260°C
Storage temperature range, T_{stg} . . . . . –65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values are with respect to the network ground terminal.
2. Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

			MIN	MAX	UNIT
V_{CC}	Supply voltage		3.6	18	V
V_{IH}	High-level input voltage	$\overline{\text{RESIN}}$	2	18	V
V_{IL}	Low-level input voltage	$\overline{\text{RESIN}}$	0	0.8	V
V_I	Input voltage	SENSE	0	18	V
I_{OH}	High-level output current	RESET		20	mA
I_{OL}	Low-level output current	$\overline{\text{RESET}}$		20	mA
T_A	Operating free-air temperature range	TL77xxBC	–0	70	°C
		TL77xxBI	–40	85	
		TL7705BQ	–40	125	
		TL7705BM	–55	125	

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER			TEST CONDITIONS†		TL77xxBC, TL77xxBI, TL7705BQ			UNIT
					MIN	TYP	MAX	
V_{OH}	High-level output voltage, RESET		I_{OH} = –16 mA		V_{CC}–1.5			V
V_{OL}	Low-level output voltage, $\overline{\text{RESET}}$		I_{OL} = 16 mA				0.4	V
V_{ref}	Reference voltage, REF		I_{ref} = 500 µA,	T_A = 25°C	2.48	2.53	2.58	V
$V_{IT–}$	Negative-going input threshold voltage at SENSE input	TL7702B	T_A = 25°C		2.505	2.53	2.555	V
		TL7705B			4.5	4.55	4.6	
		TL7733B			3.03	3.08	3.13	
		TL7702B	T_A = full range‡		2.48	2.53	2.58	
		TL7705B			4.45	4.55	4.65	
		TL7733B			3	3.08	3.16	
V_{hys}	Hysteresis, SENSE ($V_{IT+} – V_{IT–}$)	TL7702B	V_{CC} = 3.6 V to 18 V,	T_A = 25°C		10		mV
		TL7705B				30		
		TL7733B				10		
V_{res}§	Power-up reset voltage		I_{OL} at $\overline{\text{RESET}}$ = 2 mA,	T_A = 25°C			1	V
I_I	Input current	$\overline{\text{RESIN}}$	V_I = 0.4 V to V_{CC}				–10	µA
		SENSE TL7702B	V_I = V_{ref} to 18 V			–0.1	–2	
I_{OH}	High-level output current, $\overline{\text{RESET}}$		V_O = 18 V,	See Figure 1			50	µA
I_{OL}	Low-level output current, RESET		V_O = 0 V,	See Figure 1			–50	µA
I_{CC}	Supply current		V_{SENSE} = 15 V,	$\overline{\text{RESIN}}$ ≥ 2 V		1.8	3	mA
			V_{CC} = 18 V,	T_A = full range‡			3.5	

† All electrical characteristics are measured with 0.1-µF capacitors connected at REF, CT, and V_{CC} to GND.
‡ Full range is 0°C to 70°C for the C-suffix devices, –40°C to 85°C for the I-suffix devices, and –40°C to 125°C for the Q-suffix device.
§ This is the lowest voltage at which $\overline{\text{RESET}}$ becomes active.

switching characteristics, V_{CC} = 5 V, C_T open, T_A = 25°C

PARAMETER		FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	TL77xxBC, TL77xxBI, TL7705BQ			UNIT
					MIN	TYP	MAX	
t_{PLH}	Propagation delay time from low- to high-level output	$\overline{\text{RESIN}}$	RESET	See Figures 1, 2, and 3		270	500	ns
t_{PHL}	Propagation delay time from high- to low-level output	$\overline{\text{RESIN}}$	$\overline{\text{RESET}}$	See Figures 1, 2, and 3		270	500	ns
t_w	Effective pulse duration	$\overline{\text{RESIN}}$		See Figure 2		150		ns
		SENSE				100		
t_r	Rise time		RESET	See Figures 1 and 3			75	ns
t_f	Fall time					150	200	
t_r	Rise time		$\overline{\text{RESET}}$	See Figures 1 and 3		75	150	ns
t_f	Fall time						50	

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER				TEST CONDITIONS†		TL7705BM			UNIT
						MIN	TYP	MAX	
V_{OH}	High-level output voltage, RESET			I_{OH} = –16 mA		V_{CC}–1.5			V
V_{OL}	Low-level output voltage, $\overline{\text{RESET}}$			I_{OL} = 16 mA				0.4	V
V_{ref}	Reference voltage, REF			I_{ref} = 500 µA,	T_A = 25°C	2.48	2.53	2.58	V
$V_{IT–}$	Negative-going input threshold voltage at SENSE input		TL7702B	T_A = 25°C		2.505	2.53	2.555	V
			TL7705B			4.5	4.55	4.6	
			TL7702B	T_A = –55°C to 125°C		2.48	2.53	2.58	
			TL7705B			4.45	4.55	4.65	
V_{hys}	Hysteresis, SENSE ($V_{IT+} - V_{IT–}$)		TL7702B	V_{CC} = 3.6 V to 18 V,	T_A = 25°C		10		mV
			TL7705B				30		
V_{res}‡	Power-up reset voltage			I_{OL} at $\overline{\text{RESET}}$ = 2 mA,	T_A = 25°C			1	V
I_I	Input current	$\overline{\text{RESIN}}$		V_I = 0.4 V to V_{CC}				–10	µA
		SENSE	TL7702B	V_I = V_{ref} to V_{CC} – 1.5 V			–0.1	–2	
I_{OH}	High-level output current, $\overline{\text{RESET}}$			V_O = 18 V				50	µA
I_{OL}	Low-level output current, RESET			V_O = 0				–50	µA
I_{CC}	Supply current			V_{SENSE} = 15 V,	$\overline{\text{RESIN}} \geq 2$ V		1.8	3	mA
				V_{CC} = 18 V,	T_A = –55°C to 125°C			4	

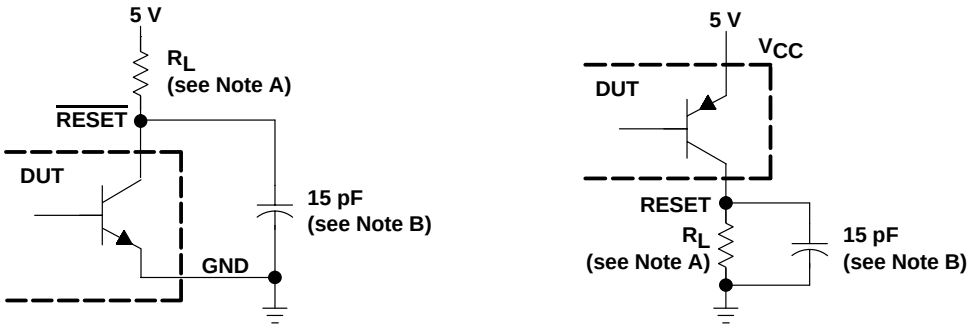
† All electrical characteristics are measured with 0.1-µF capacitors connected at REF, CT, and V_{CC} to GND.
‡ This is the lowest value at which $\overline{\text{RESET}}$ becomes active.

switching characteristics, V_{CC} = 5 V, C_T open, T_A = 25°C

PARAMETER		FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	TL7705BM			UNIT
					MIN	TYP	MAX	
t_{PLH}	Propagation delay time from low- to high-level output	$\overline{\text{RESIN}}$	RESET	See Figures 1, 2, and 3		270	500*	ns
t_{PHL}	Propagation delay time from high- to low-level output	$\overline{\text{RESIN}}$	$\overline{\text{RESET}}$	See Figures 1, 2, and 3		270	500*	ns
t_w	Effective pulse duration	$\overline{\text{RESIN}}$		See Figure 2		150		ns
		SENSE				100		
t_r	Rise time		RESET	See Figures 1 and 3			75*	ns
t_f	Fall time					150	200*	
t_r	Rise time		$\overline{\text{RESET}}$	See Figures 1 and 3		75	150*	ns
t_f	Fall time						50*	

* On products compliant to MIL-PRF-38535, these parameters are not production tested.

PARAMETER MEASUREMENT INFORMATION



RESET OUTPUT CONFIGURATION | RESET OUTPUT CONFIGURATION

NOTES: A. For I_{OL} and I_{OH}, R_L = 10 kΩ. For all switching characteristics, R_L = 511 Ω.
B. This figure includes jig and probe capacitance.

Figure 1. RESET and RESET Output Configurations

WAVEFORMS

Figure 2. Input Pulse Definition

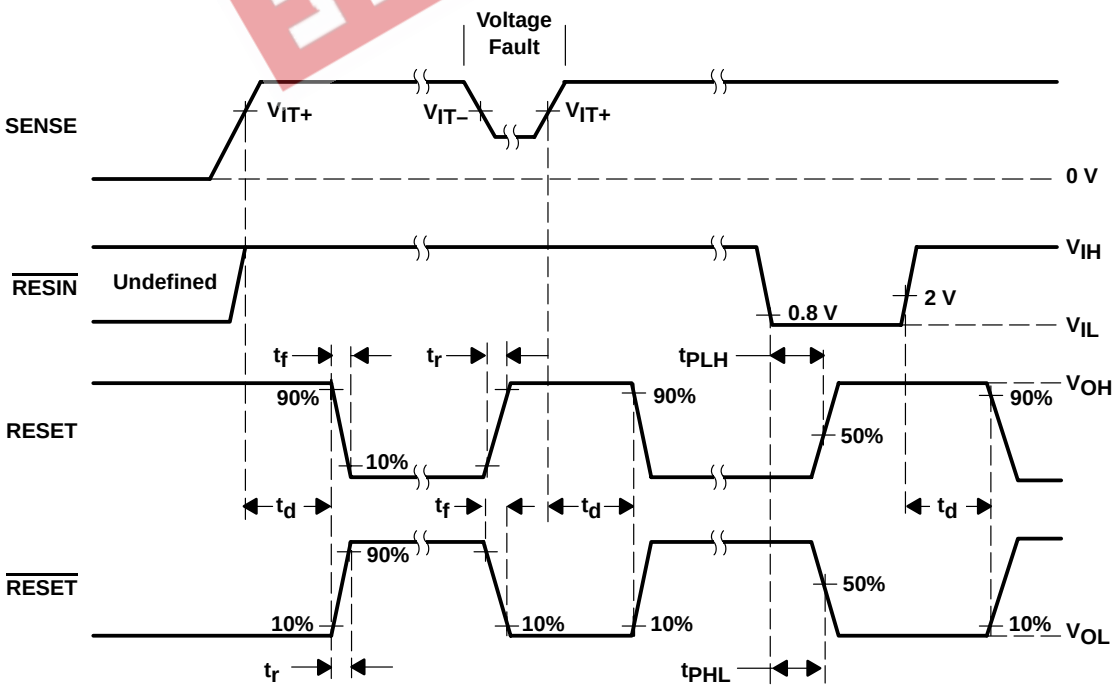


Figure 3. Voltage Waveforms

TYPICAL CHARACTERISTICS†

ASSERTION TIME vs LOAD RESISTANCE

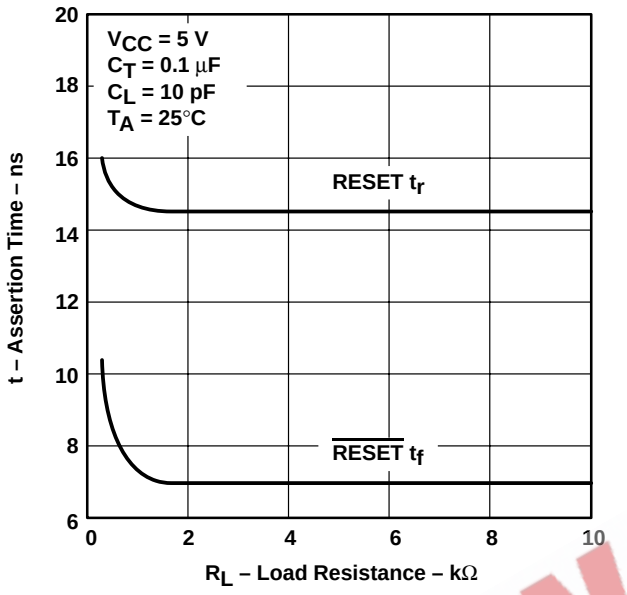


Figure 4

DEASSERTION TIME vs LOAD RESISTANCE

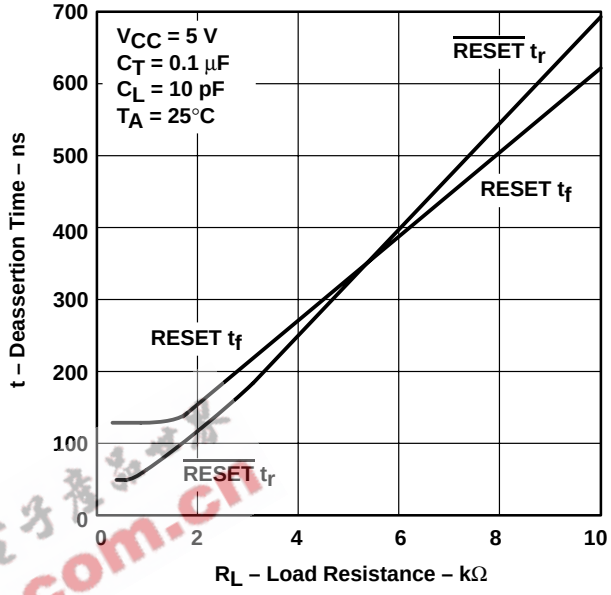


Figure 5

ASSERTION TIME vs LOAD CAPACITANCE

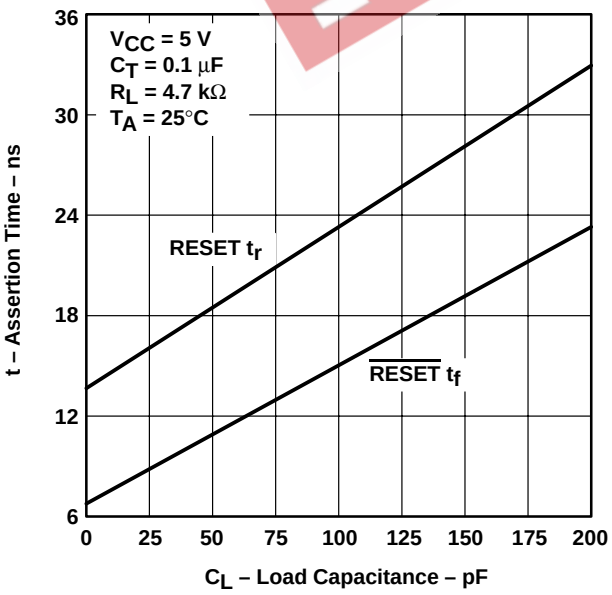


Figure 6

DEASSERTION TIME vs LOAD CAPACITANCE

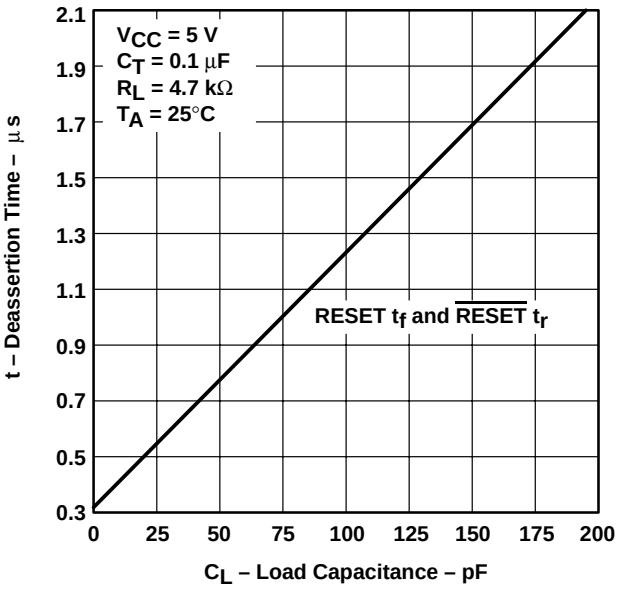


Figure 7

† For proper operation, both RESET and $\overline{\text{RESET}}$ should be terminated with resistors of similar value. Failure to do so may cause unwanted plateauing in either output waveform during switching.

APPLICATION INFORMATION

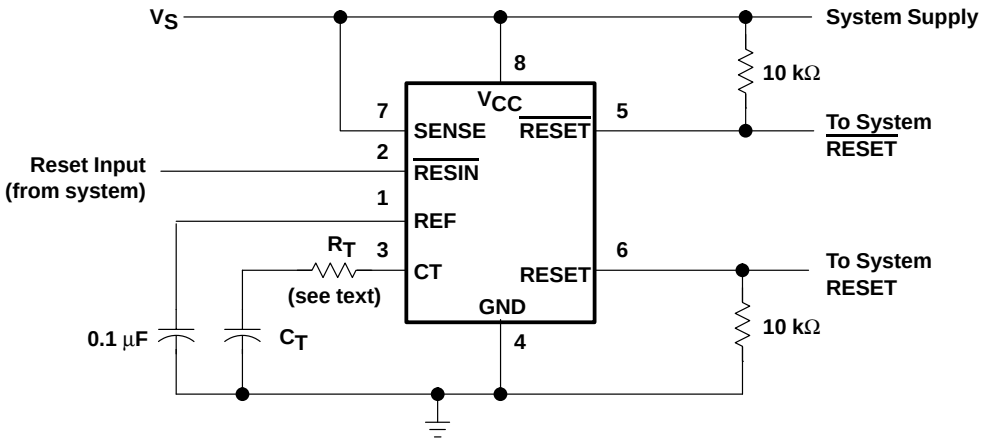


Figure 8. System Reset Controller With Undervoltage Sensing

When the TL770xB SENSE terminal is used to monitor V_{CC}, a current-limiting resistor in series with C_T is recommended. During normal operation, the timing capacitor is charged by the onboard current source to approximately V_{CC} or an internal voltage clamp (≈7.1-V zener), whichever is less. When the circuit is then subjected to an undervoltage condition during which V_{CC} is rapidly slewed down, the voltage on CT exceeds that on V_{CC}. This forward biases a secondary path internally, which falsely activates the outputs. A fault is indicated when V_{CC} drops below $V_{(CT)}$, not when V_{SENSE} falls below V_{T-}.

Texas Instruments performs a 100% electrical screen to verify that the outputs do not switch with 1 mA forced into the CT terminal. Adding the external resistor, R_T, prevents false triggering. Its value is calculated as follows:

$$\frac{V_{(CT)} - V_{T-}}{R_T}$$

Where:

$V_{(CT)}$ = V_{CC} or 7.1 V, whichever is less
V_{T-} = 4.55 V (nom)
R_T = value of series resistor required

For V_{CC} = 5 V:

$$\frac{5 - 4.55}{R_T} < 1 \text{ mA}$$

Therefore,

$$R_T > 450\ \Omega$$

Using a 20%-tolerance resistor, R_T should be greater than 560 Ω.

Adding this series resistor changes the duration of the reset pulse by no more than 10%. R_T extends the discharge of C_T, but also skews the $V_{(CT)}$ threshold. These effects tend to cancel one another. The precise percentage change can be derived theoretically, but the equation is complicated by this interaction and is dependent upon the duration of the supply-voltage fault condition.

Both outputs of the TL770xB should be terminated with similar value resistors, even when only one is being used. This prevents unwanted plateauing in either output waveform during switching, which may be interpreted as an undefined state or delay system reset.

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